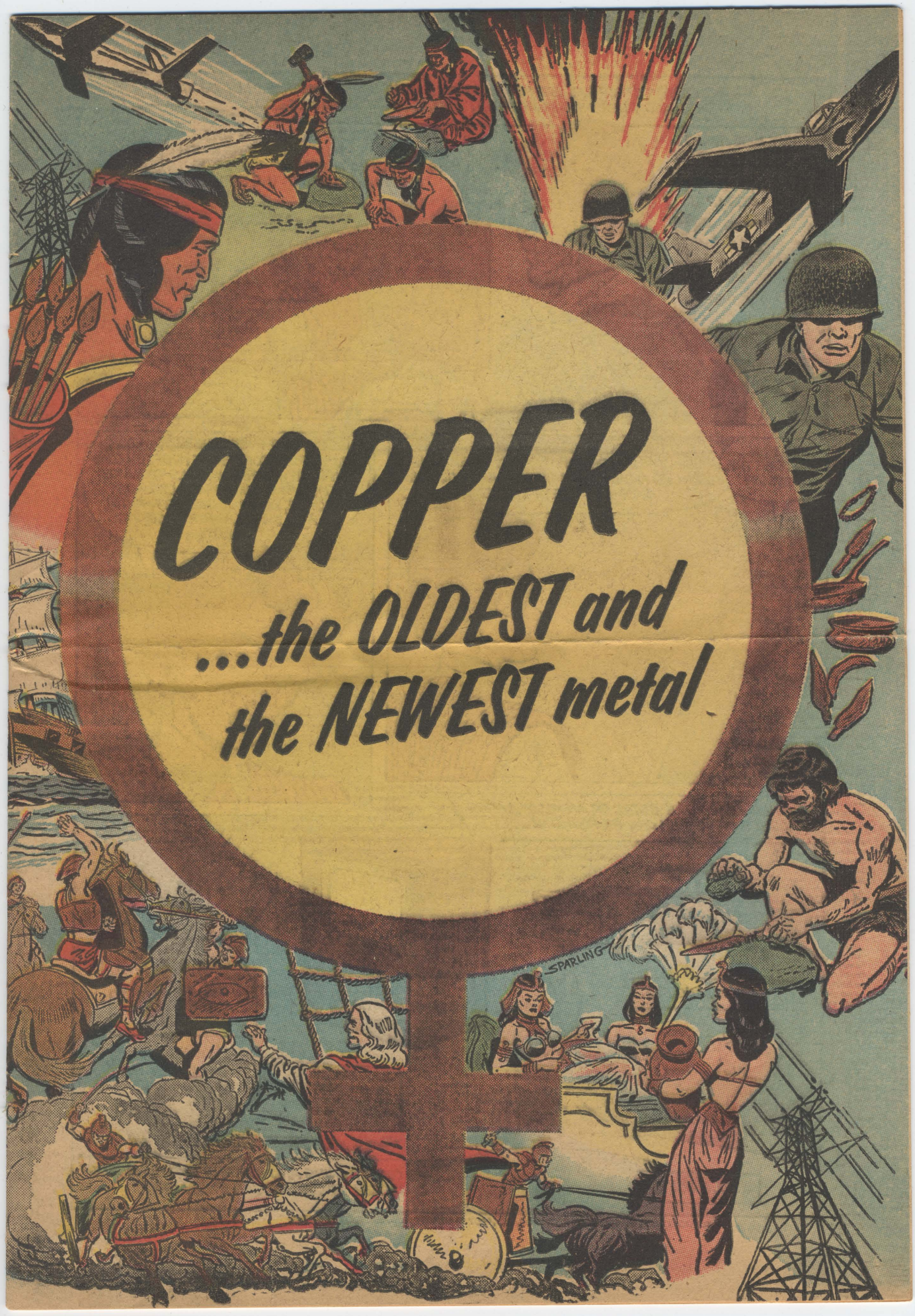
COPPER
...the OLDEST and
the NEWEST metal
SPARLING

THROUGH THE AGES, COPPER HAS BEEN ONE OF MAN'S MOST USEFUL METALS. LET US VISIT A SCIENCE CLASS WHERE THIS IMPORTANT METAL IS BEING DISCUSSED...

BUT, MISS ADAMS... HOW CAN COPPER BE BOTH THE *OLDEST* AND THE *NEWEST* METAL?

IT'S THE OLDEST BECAUSE IT WAS THE FIRST USED BY MAN. BRASS, WHICH IS COMPOSED MOSTLY OF COPPER, IS EVEN MENTIONED IN THE BIBLE!

THEN HOW CAN IT BE THE NEWEST?

IT'S THE NEWEST BECAUSE WE'RE ALWAYS FINDING NEW USES FOR IT. MANY INVENTIONS TODAY, AS ALL THROUGH HISTORY, ARE POSSIBLE ONLY BECAUSE OF COPPER!

JUST ABOUT EVERYWHERE YOU LOOK, YOU'LL FIND COPPER. IT IS OFTEN COMBINED WITH OTHER METALS TO MAKE ALLOYS. TWO COMMON ALLOYS ARE BRONZE, WHICH IS COPPER AND TIN, AND BRASS, WHICH IS COPPER AND ZINC!

"EITHER AS A PURE METAL OR AN ALLOY, LARGE AMOUNTS OF COPPER CAN BE FOUND IN...

...YOUR AUTOMOBILE.

...ALL TYPES OF COMMUNICATIONS.

...ELECTRIC LIGHT AND POWER.

...YOUR HOUSE.

...AIR CONDITIONING AND HEATING AND HUNDREDS OF OTHER THINGS YOU SEE EVERY DAY!"

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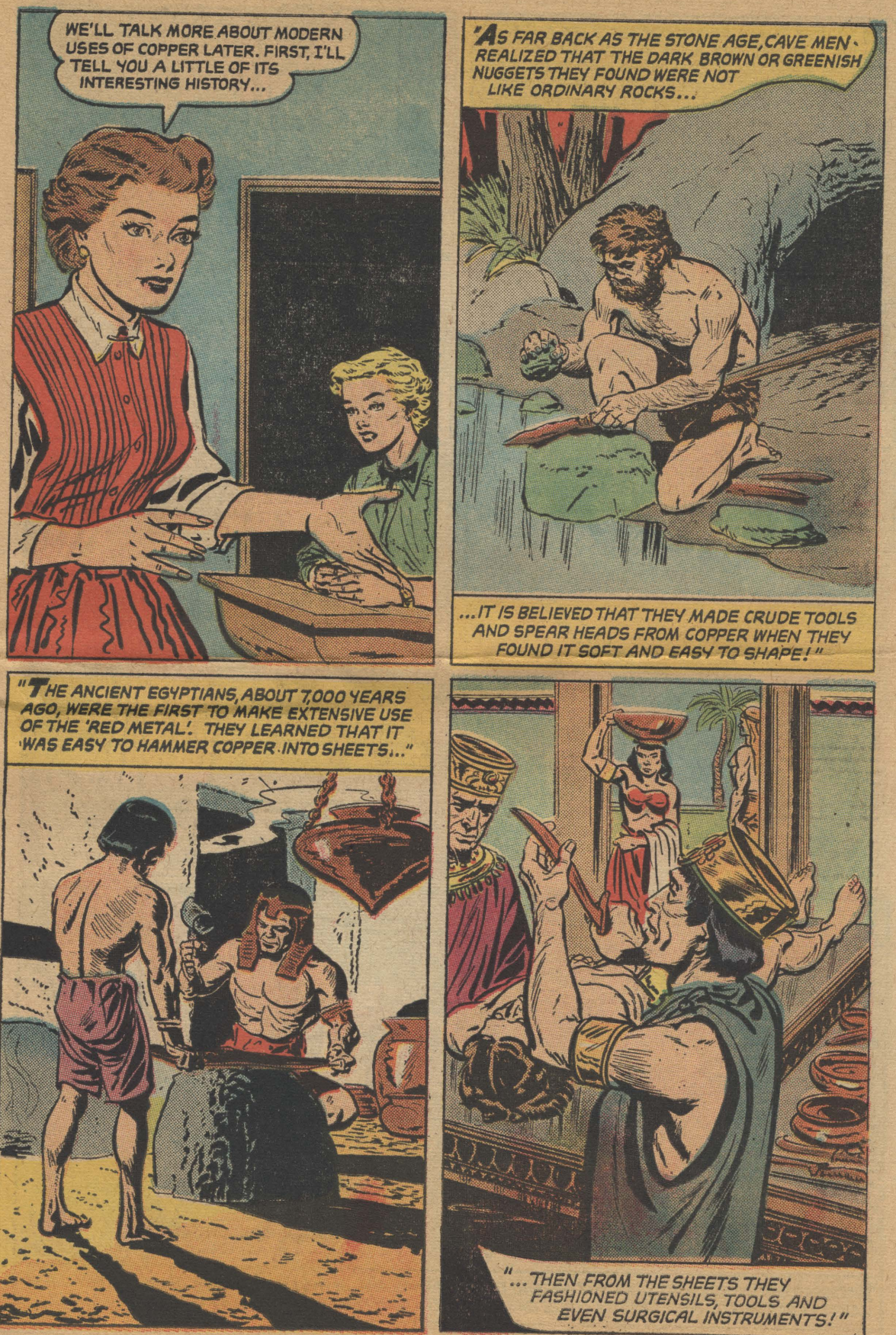

WE'LL TALK MORE ABOUT MODERN USES OF COPPER LATER. FIRST, I'LL TELL YOU A LITTLE OF ITS INTERESTING HISTORY...
"AS FAR BACK AS THE STONE AGE, CAVE MEN REALIZED THAT THE DARK BROWN OR GREENISH NUGGETS THEY FOUND WERE NOT LIKE ORDINARY ROCKS...
...IT IS BELIEVED THAT THEY MADE CRUDE TOOLS AND SPEAR HEADS FROM COPPER WHEN THEY FOUND IT SOFT AND EASY TO SHAPE!"
"THE ANCIENT EGYPTIANS, ABOUT 7,000 YEARS AGO, WERE THE FIRST TO MAKE EXTENSIVE USE OF THE 'RED METAL'. THEY LEARNED THAT IT WAS EASY TO HAMMER COPPER INTO SHEETS..."
"... THEN FROM THE SHEETS THEY FASHIONED UTENSILS, TOOLS AND EVEN SURGICAL INSTRUMENTS!"

"A UNIQUE THING ABOUT COPPER IS ITS RUST-PROOF QUALITY. NOT MANY YEARS AGO A PIECE OF PIPE 5,500 YEARS OLD, WHICH HAD BEEN USED TO CONVEY WATER TO AN EGYPTIAN PHARAOH'S SWIMMING POOL, WAS FOUND IN A PYRAMID...

...THE PIPE CAN STILL CARRY WATER!"

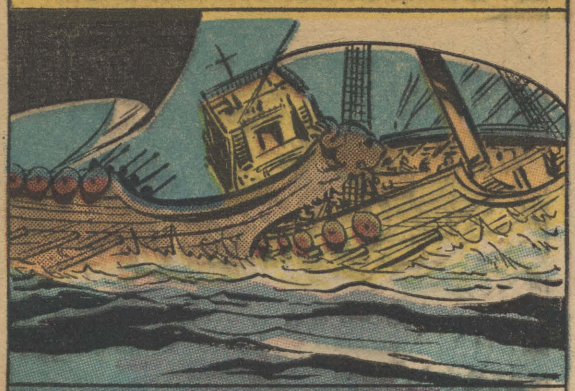
"MUCH OF THE HISTORY WE KNOW ABOUT ANCIENT PEOPLES IS LEARNED FROM COPPER OBJECTS WHICH HAVE LASTED THROUGH THE CENTURIES!"

"A COPPER FRYING PAN 5,000 YEARS OLD IS ON DISPLAY AT THE UNIVERSITY OF PENNSYLVANIA MUSEUM. IT IS STILL SERVICEABLE, AND RECENTLY HAS BEEN USED TO FRY AN EGG!"

"JUST AS COPPER IS IMPORTANT IN MAKING JEWELRY TODAY, IT WAS USED THOUSANDS OF YEARS AGO TO MAKE ORNAMENTS AND JEWELRY FOR THE EGYPTIAN WOMEN!"

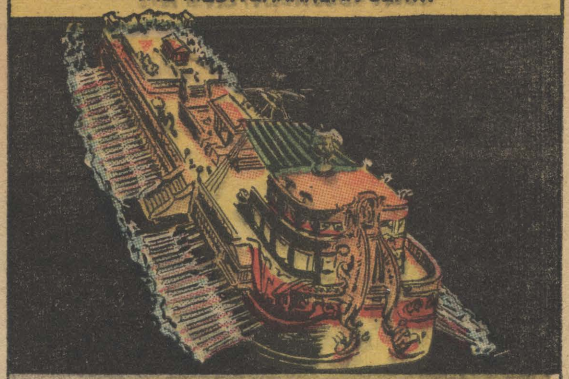
"NATIONS THEN, AS NOW, HAD WARS. BUT INSTEAD OF JET PLANES AND TANKS LIKE WE HAVE TODAY, THE EGYPTIANS USED SPEAR HEADS AND SWORDS MADE OF COPPER. THEIR DEFENSIVE ARMOR WAS COPPER SHIELDS!"

"EVEN ON THE SEA, THERE WAS A USE FOR COPPER. EGYPTIAN WARSHIPS, OR GALLEYS, OFTEN HAD FIGURES OF RAMS ON THE BOWS. THE OUTER SURFACE OF THESE RAMS WAS A HARD COAT OF BRONZE...

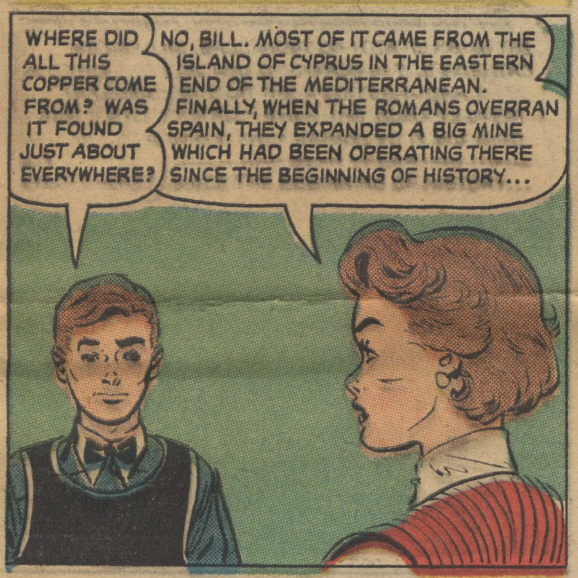


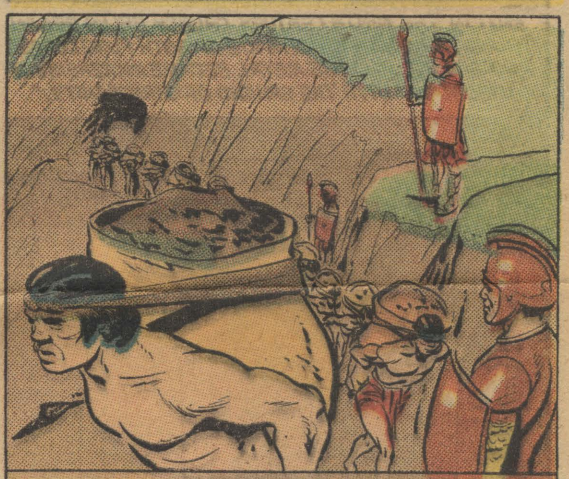
...A VICTORIOUS VESSEL COULD OFTEN DESTROY ITS VICTIM BY RAMMING IT WITH THE STURDY BOW!"

"SEVERAL CENTURIES LATER, OTHER USES WERE FOUND FOR COPPER IN BUILDING SHIPS ACROSS THE MEDITERRANEAN SEA...

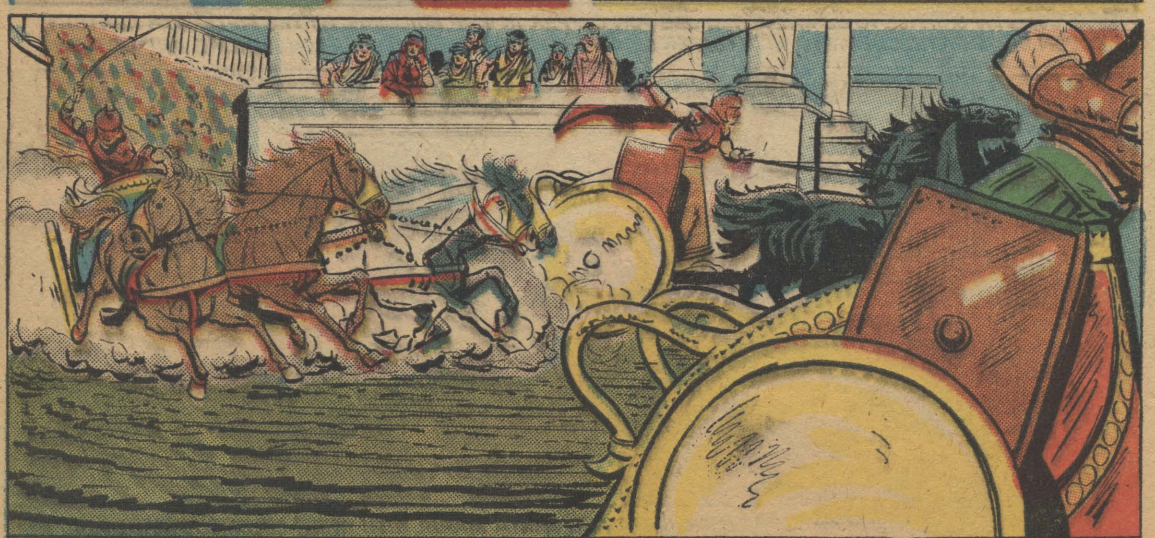


... IN 1929 A ROMAN SHIP WAS UNCOVERED AFTER 1,000 YEARS OF IMMERSION IN LAKE NEMI, ITALY. THE COPPER NAILS AND SPIKES WERE STILL PERFECTLY PRESERVED!"


WHERE DID ALL THIS COPPER COME FROM? WAS IT FOUND JUST ABOUT EVERYWHERE?
NO, BILL. MOST OF IT CAME FROM THE ISLAND OF CYPRUS IN THE EASTERN END OF THE MEDITERRANEAN. FINALLY, WHEN THE ROMANS OVERRAN SPAIN, THEY EXPANDED A BIG MINE WHICH HAD BEEN OPERATING THERE SINCE THE BEGINNING OF HISTORY...

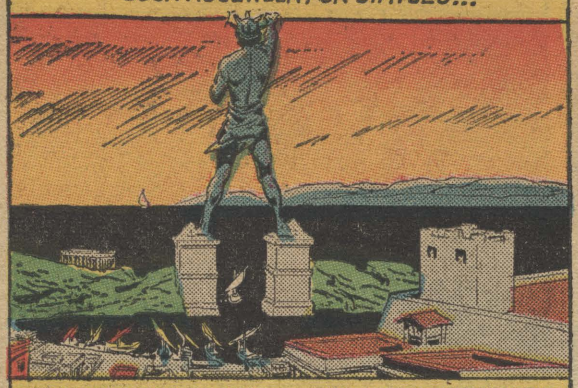


"THOUSANDS OF SLAVES WERE USED TO MINE AND TRANSPORT THE METAL TO NEARBY PORTS, FROM WHICH IT WAS SHIPPED TO THE ROMAN STATE..."



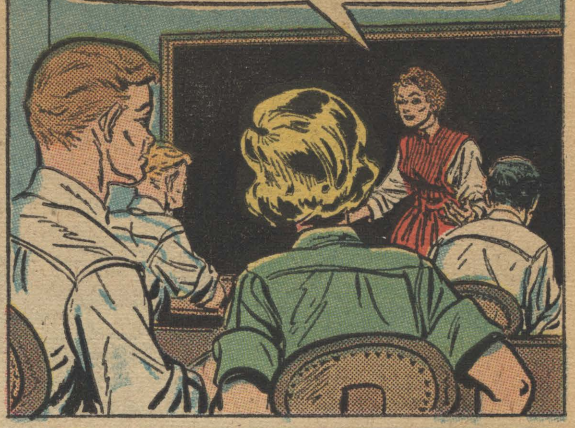
"CONTROL OF THE VALUABLE SPANISH MINE ACCOUNTED FOR MUCH OF THE GRANDEUR OF ANCIENT ROME!"

"THE BIRTH OF CIVILIZATION CAME WITH THE 'BRONZE AGE.' COPPER AND ITS ALLOYS PROVIDED TOOLS, WEAPONS, IMPLEMENTS, AND ORNAMENTS SUCH AS JEWELRY OR STATUES...

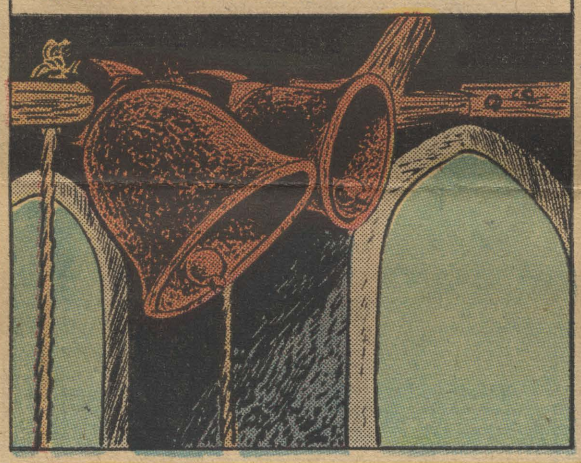


...THE COLOSSUS OF RHODES, THEN CALLED ONE OF THE 'SEVEN WONDERS OF THE WORLD,' WAS A GIGANTIC BRONZE STATUE BUILT TO OVERLOOK THE AGEAN SEA!"

AFTER THE BRONZE AGE CAME THE "MIDDLE AGES", A PERIOD DURING WHICH THE ADVANCE OF EUROPEAN ART AND CULTURE CAME ALMOST TO A STANDSTILL. WHEN CIVILIZATION MARKED TIME, FEW NEW USES FOR COPPER WERE FOUND!



"BUT IN THE NINTH CENTURY, CHURCH BELLS BEGAN TO APPEAR WHICH WERE MADE OF BOTH PURE COPPER AND BRONZE, AND THE METAL BECAME INCREASINGLY IMPORTANT WITH THE SPREAD OF CHRISTIANITY."



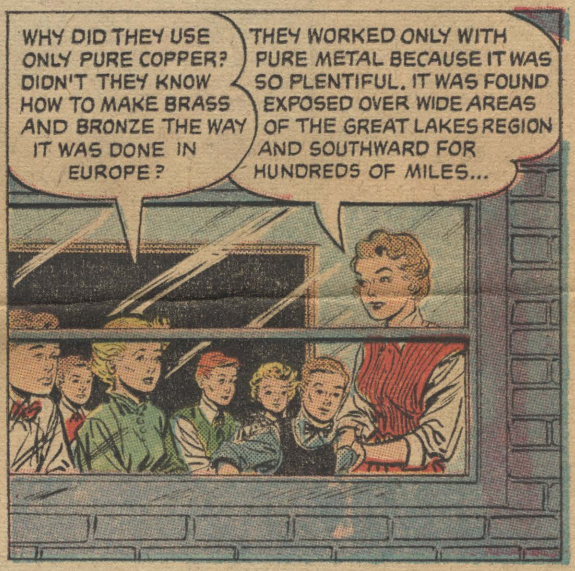
"BY THE FOURTEENTH CENTURY, CHURCHES WERE BEING BUILT WITH COPPER ROOFS. HILDESHEIM CATHEDRAL IN GERMANY, WHICH WAS COMPLETED IN 1320, HAD A COPPER ROOF THAT REMAINED IN PERFECT CONDITION UNTIL THE STRUCTURE WAS DESTROYED BY BOMBS IN WORLD WAR II..."

"OF SPECIAL IMPORTANCE TO US WAS A NEW USE FOR COPPER IN SHIP BUILDING. BY THE FIFTEENTH CENTURY, WOODEN SHIPS WERE SHEATHED WITH COPPER BELOW THE WATER LINE TO INSURE LONGER LIFE AND GREATER PROTECTION...

...THE NINA, PINTA AND SANTA MARIA, WITH WHICH COLUMBUS MADE HIS VOYAGE TO AMERICA, WERE COPPER COVERED IN THIS WAY!"

"AT THE TIME COLUMBUS MADE HIS VOYAGE, THE AMERICAN INDIANS, IN MANY WAYS, WERE AS ADVANCED IN WORKING COPPER AS THE EUROPEANS..."

"...FROM THE PURE METAL THEY MADE TOOLS, FISHHOOKS AND ARROWHEADS. THEIR CHIEF ORNAMENTS WERE COPPER NECKLACES!"

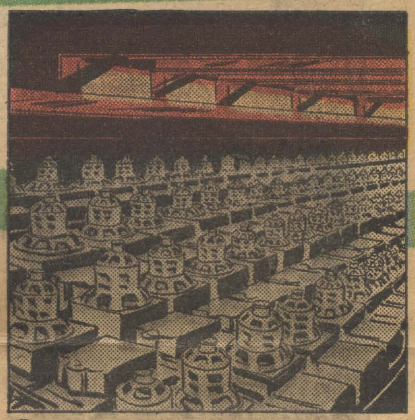

WHY DID THEY USE ONLY PURE COPPER? DIDN'T THEY KNOW HOW TO MAKE BRASS AND BRONZE THE WAY IT WAS DONE IN EUROPE?
THEY WORKED ONLY WITH PURE METAL BECAUSE IT WAS SO PLENTIFUL. IT WAS FOUND EXPOSED OVER WIDE AREAS OF THE GREAT LAKES REGION AND SOUTHWARD FOR HUNDREDS OF MILES...

"AND ALTHOUGH THEIR METHODS WERE CRUDE, THE INDIANS DUG MINES INTO THE EARTH MUCH THE SAME AS WE DO TO GET SOME OF OUR COPPER TODAY!"

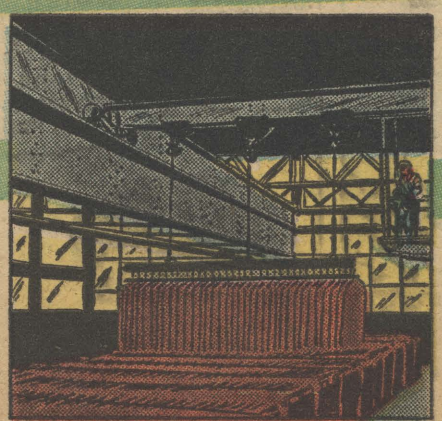
DOES ALL OF THE COPPER WE USE TODAY COME FROM MINES?
YES, BUT THERE ARE DIFFERENT TYPES OF MINES. LET ME EXPLAIN WHAT HAPPENS FROM THE TIME COPPER IS REMOVED FROM THE EARTH UNTIL IT REACHES YOU AS PART OF A MANUFACTURED PRODUCT...

"WHEN COPPER DEPOSITS ARE FOUND NEAR THE SURFACE OF THE EARTH, THE 'OPEN PIT' TYPE OF MINE IS USED. IN THIS CASE, HUGE ELECTRIC SHOVELS CUT AWAY AN ENTIRE MOUNTAIN IN TIERS, LEAVING THE COPPER ORE EXPOSED...

NEXT, THE ORE IS TRANSPORTED BY RAIL TO A MILL WHERE IT IS CRUSHED...



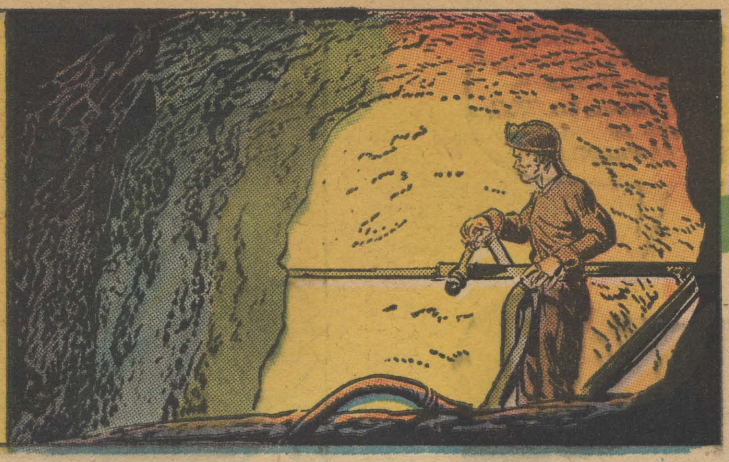
GENERALLY SPEAKING, WATER, OILS AND CHEMICALS ARE ADDED TO THE CRUSHED ORE, CAUSING COPPER AND OTHER METAL PARTICLES TO COLLECT IN FROTH ON THE SURFACE. THEN THEY ARE FLOATED OFF AND DRIED...

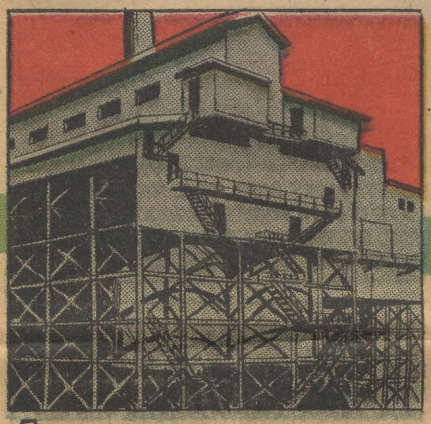


AT THE ELECTROLYTIC REFINERY, 98% PURE METAL IS PLACED IN TANKS AND FURTHER REFINED. OVER A 28-DAY PERIOD, ALMOST 100 PER CENT PURE COPPER IS PRODUCED.

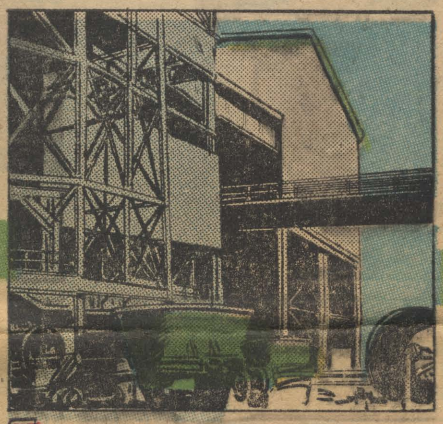
THE PURE COPPER IS THEN CAST INTO BILLETS, SLABS, CAKES, WIRE BARS AND INGOTS...

...HOWEVER, COPPER MAY BE FOUND AS DEEP AS A MILE UNDERGROUND. WHERE IT CANNOT BE MINED BY THE OPEN PIT METHOD, THE ORE IS BROUGHT TO THE SURFACE THROUGH SHAFTS.



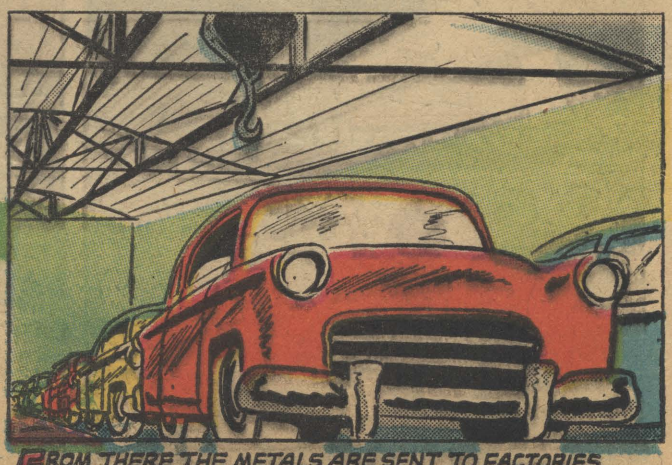


AFTER THAT, THEY ARE SENT TO A ROASTING PLANT WHERE THEY ARE HEATED TO REMOVE MOST OF THE SULPHUR...



TO FURTHER PURIFY THE METAL, IT IS MELTED IN LARGE FURNACES WHERE THE IMPURITIES FORM SLAG WHICH IS SKIMMED AND DUMPED...

AT THE FABRICATING PLANTS, COPPER AND ITS ALLOYS ARE FORMED INTO SHEET AND STRIP, TUBE AND WIRE AND OTHER SHAPES, READY FOR MANUFACTURING...



FROM THERE THE METALS ARE SENT TO FACTORIES WHERE THEY ARE MADE PART OF THE OBJECTS WE USE AND ENJOY EVERY DAY!"

MODERN METHODS OF MINING, REFINING, FABRICATING AND MANUFACTURING COPPER INTO USEFUL PRODUCTS HAVE RESULTED FROM A NEVER-ENDING DEMAND TO MEET NEW NEEDS...

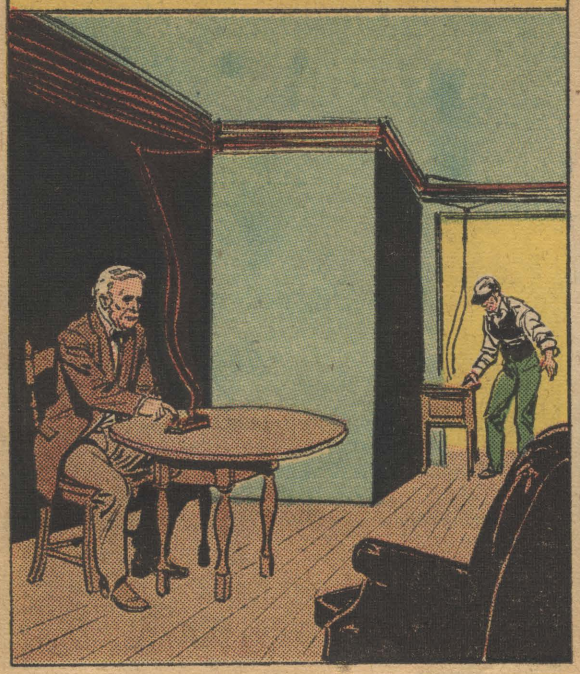
"THE HISTORY OF AMERICA IS ONE OF PROGRESS THROUGH INVENTIONS, AND MOST INVENTIONS, IN SOME WAY HAVE BEEN DEPENDENT ON COPPER...

...IN THE REVOLUTIONARY WAR, PAUL REVERE CONTRIBUTED TO OUR VICTORY BY PRODUCING THE BRASS CANNON, SPIKES AND PUMPS FOR THE FAMOUS SHIP, 'OLD IRONSIDES'!"

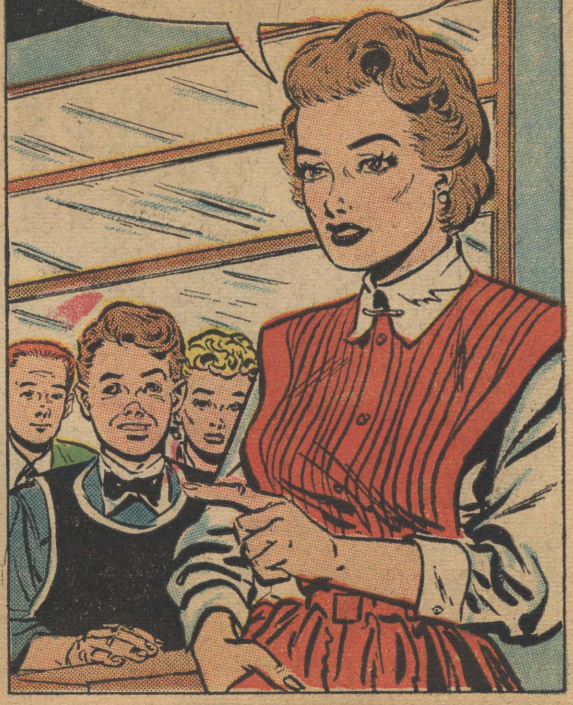
"AFTER THE WAR HE ADVANCED THE SHIPPING INDUSTRY BY PRODUCING COPPER PLATES AND BOILERS FOR THE STEAMBOAT INVENTED BY ROBERT FULTON..."

"IT WAS BENJAMIN FRANKLIN, INVENTOR AND AUTHOR, WHO OPENED THE DOOR TO SCIENTIFIC ADVANCEMENT. IN 1752, BY USING A KITE, STRING AND BRASS KEY, HE PROVED THAT LIGHTNING FLASHES AND ELECTRICAL DISCHARGES WERE THE SAME. THE BIG QUESTION, THEN, WAS HOW TO HARNESS THIS POWER!"

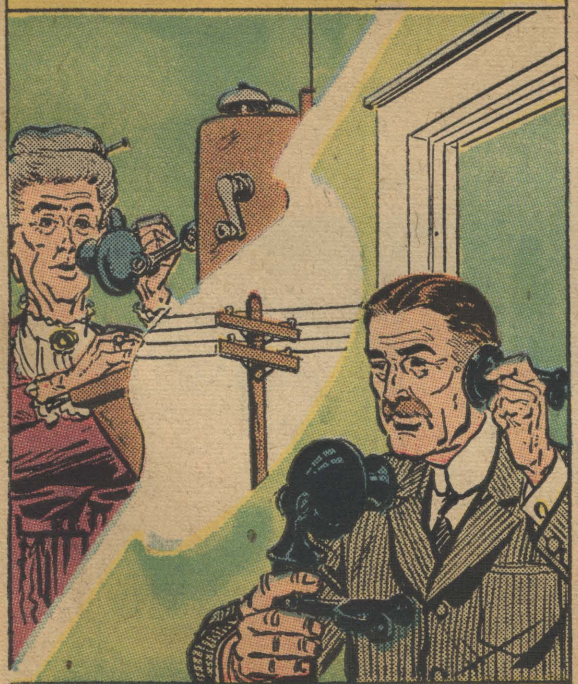
"IT WAS OBVIOUS THAT COPPER, THE MOST EFFICIENT COMMERCIAL CONDUCTOR OF ELECTRICITY, WOULD HAVE TO PLAY AN IMPORTANT ROLE. IN 1832, SAMUEL F.B. MORSE MADE AN EARLY CONTRIBUTION TO THE USE OF ELECTRICITY IN COMMUNICATIONS WHEN HE STRETCHED 1,700 FEET OF WIRE AROUND HIS ROOM AND TRANSMITTED SIGNALS FROM ONE END TO THE OTHER..."



THAT 1,700 FEET OF WIRE WAS THE *FIRST* ELECTRICAL TELEGRAPH LINE. TODAY THERE ARE MORE THAN *SEVEN MILLION MILES* OF TELEGRAPH WIRE IN THE WORLD--ONE-THIRD OF THEM IN THE UNITED STATES!



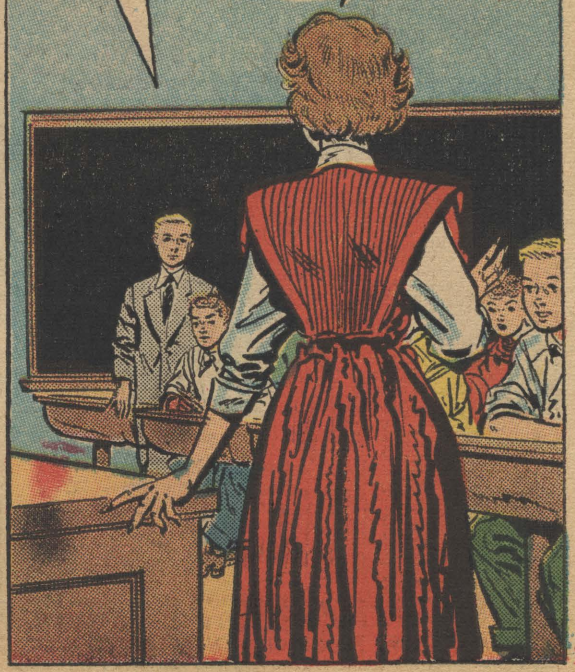
"IN 1876, ANOTHER GREAT INVENTOR NAMED ALEXANDER GRAHAM BELL PUT THE HUMAN VOICE ON COPPER WIRE WHEN HE INVENTED THE TELEPHONE...



... TODAY, THREE-QUARTERS OF A CENTURY LATER, THERE ARE FIFTY-SIX MILLION TELEPHONES IN THE UNITED STATES!"

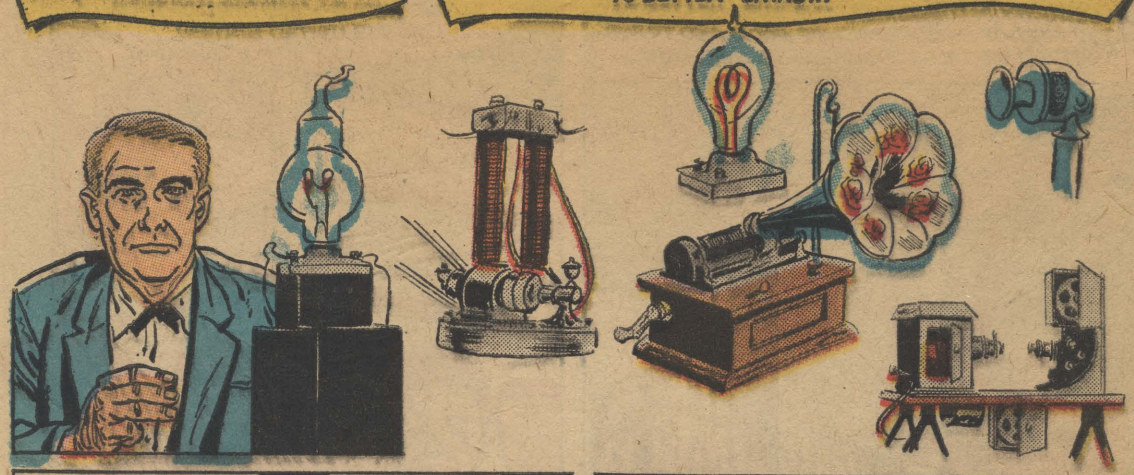
THOMAS EDISON WAS A GREAT INVENTOR, WASN'T HE? DID HE USE COPPER IN HIS EXPERIMENTS WITH ELECTRICITY?

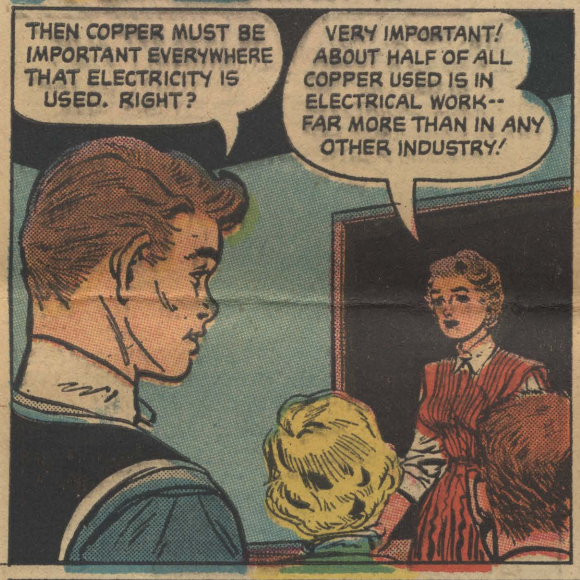
YES, IN PRACTICALLY ALL OF THEM. HE OBTAINED MORE THAN 1,200 PATENTS, ALMOST ALL OF WHICH DEPENDED UPON THE USE OF COPPER!



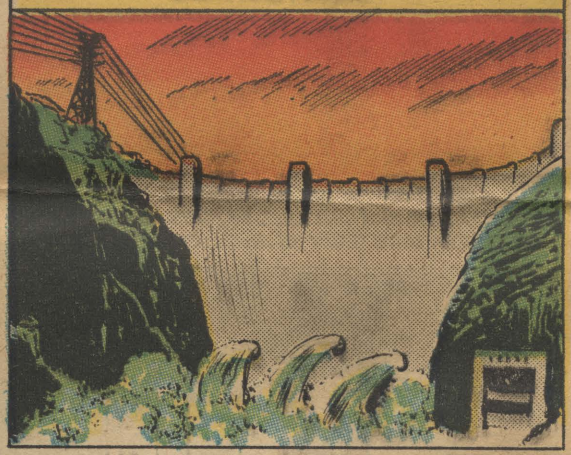
"THOMAS A. EDISON CHANGED NOT ONLY OUR NATION, BUT THE ENTIRE WORLD WHEN HE INVENTED THE INCANDESCENT ELECTRIC LAMP."

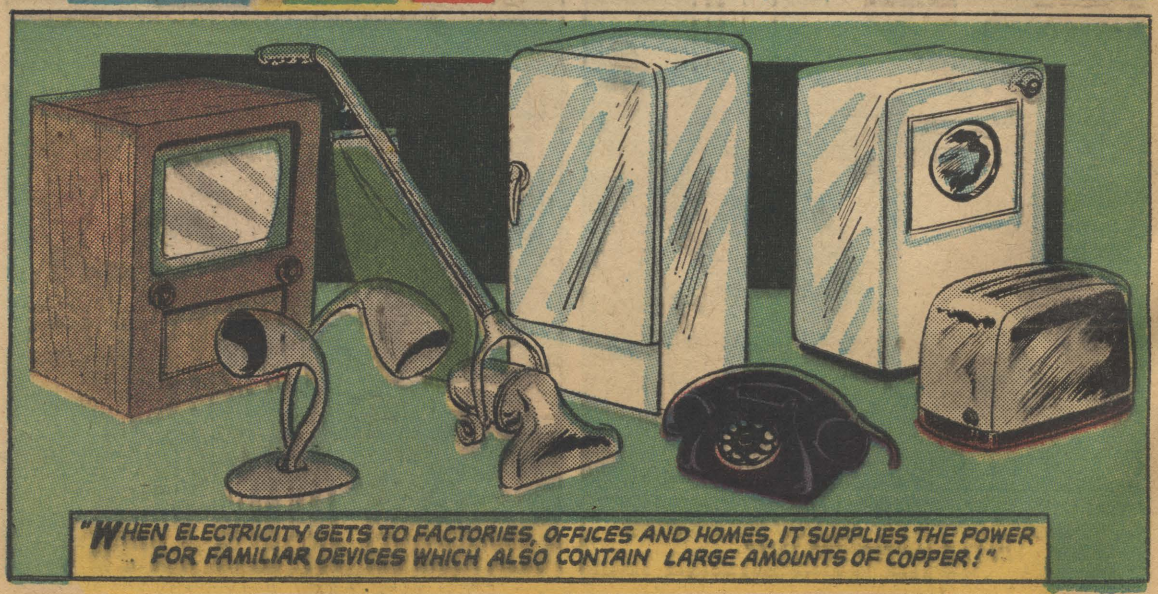
"IN HIS DAY, TO FLIP A SWITCH AND GET A BRIGHT LIGHT SEEMED LIKE MAGIC. NOW WE TAKE FOR GRANTED ELECTRIC LIGHTS AND DOZENS OF OTHER THINGS EDISON INVENTED WHICH CONTRIBUTE TO BETTER LIVING..."



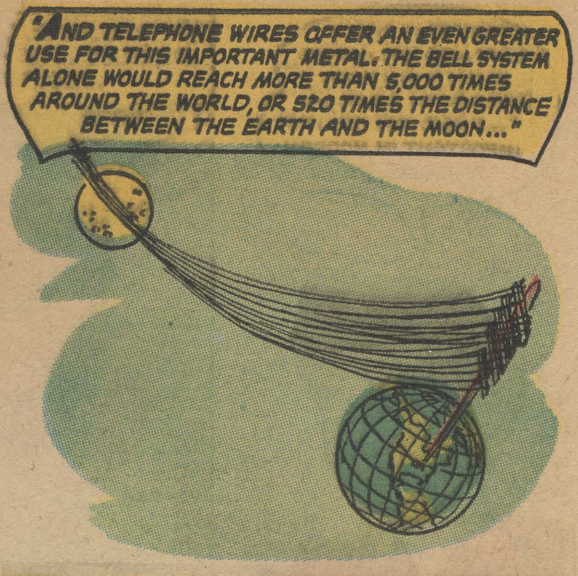

THEN COPPER MUST BE IMPORTANT EVERYWHERE THAT ELECTRICITY IS USED. RIGHT?
VERY IMPORTANT! ABOUT HALF OF ALL COPPER USED IS IN ELECTRICAL WORK-- FAR MORE THAN IN ANY OTHER INDUSTRY!

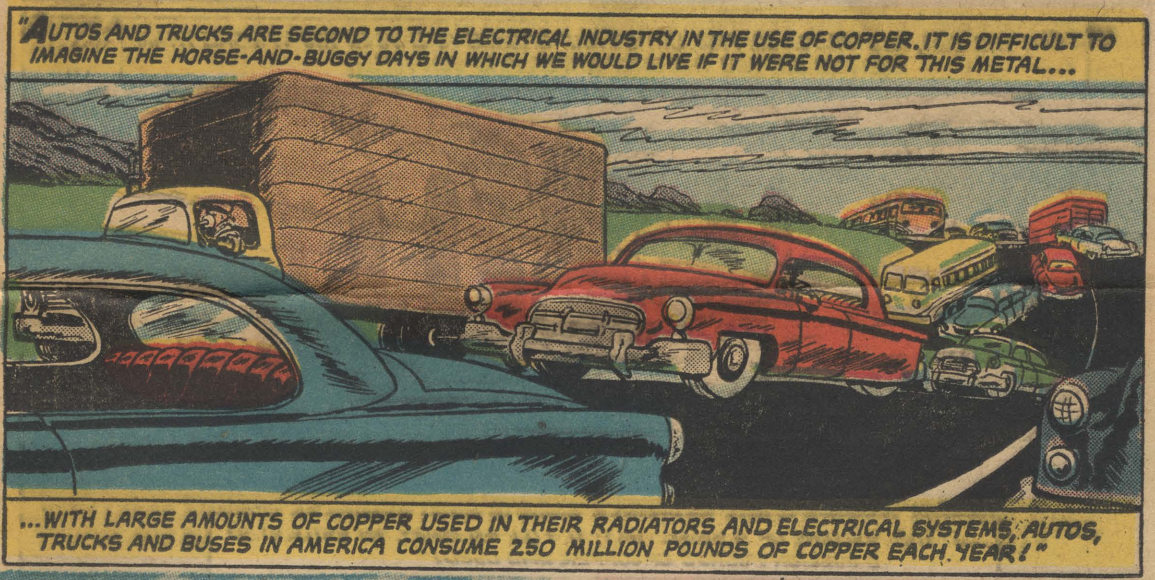
"MANY MILLIONS OF POUNDS OF THIS VALUABLE METAL ARE BEING USED RIGHT NOW TO GENERATE AND TRANSMIT ELECTRICITY FOR THE NATION'S LIGHT AND POWER..."



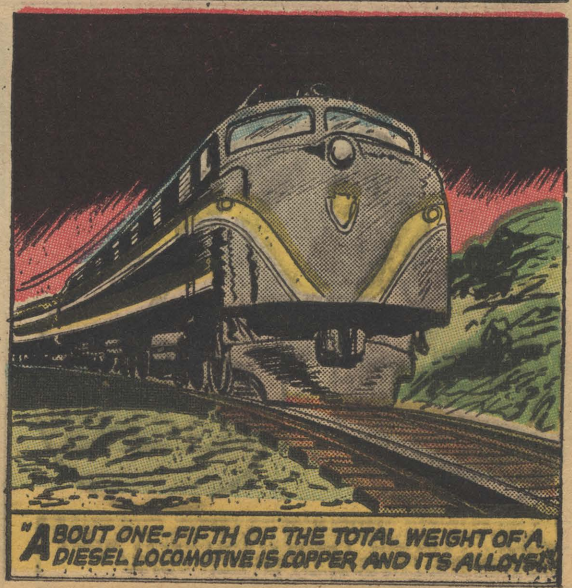

"WHEN ELECTRICITY GETS TO FACTORIES, OFFICES AND HOMES, IT SUPPLIES THE POWER FOR FAMILIAR DEVICES WHICH ALSO CONTAIN LARGE AMOUNTS OF COPPER!"

I'VE ALWAYS WONDERED HOW TELEGRAPH MESSAGES ARE SENT OVERSEAS. IS COPPER USED?
YES, THERE ARE 30,000 MILES OF UNDER-WATER COPPER CABLES LINKING US WITH OTHER NATIONS ACROSS THE OCEANS...


"AND TELEPHONE WIRES OFFER AN EVEN GREATER USE FOR THIS IMPORTANT METAL. THE BELL SYSTEM ALONE WOULD REACH MORE THAN 5,000 TIMES AROUND THE WORLD, OR 520 TIMES THE DISTANCE BETWEEN THE EARTH AND THE MOON..."


"AUTOS AND TRUCKS ARE SECOND TO THE ELECTRICAL INDUSTRY IN THE USE OF COPPER. IT IS DIFFICULT TO IMAGINE THE HORSE-AND-BUGGY DAYS IN WHICH WE WOULD LIVE IF IT WERE NOT FOR THIS METAL...
...WITH LARGE AMOUNTS OF COPPER USED IN THEIR RADIATORS AND ELECTRICAL SYSTEMS, AUTOS, TRUCKS AND BUSES IN AMERICA CONSUME 250 MILLION POUNDS OF COPPER EACH YEAR!"

"COPPER IN RAILROADS IS BECOMING MORE AND MORE IMPORTANT. IN THIS INDUSTRY TODAY ARE MORE THAN A BILLION POUNDS OF COPPER!"


"ABOUT ONE-FIFTH OF THE TOTAL WEIGHT OF A DIESEL LOCOMOTIVE IS COPPER AND ITS ALLOYS!"

YOU'VE ALREADY LEARNED HOW COPPER WAS USED IN ANCIENT WARS BOTH AS ARMAMENT AND ARMOR. IT IS IMPORTANT IN MODERN WARFARE, TOO...

"IN WORLD WAR II, TANKS, PLANES, RADAR, GUNS AND AMMUNITION REQUIRED HUGE AMOUNTS OF THIS NECESSARY METAL AND ITS ALLOYS IN BRINGING ABOUT OUR VICTORY..."

"ON THE SEA, RUSTPROOF COPPER, BRASS AND BRONZE ARE USED TODAY MORE THAN EVER TO ENDURE THE SALT WATER AND SEA AIR...

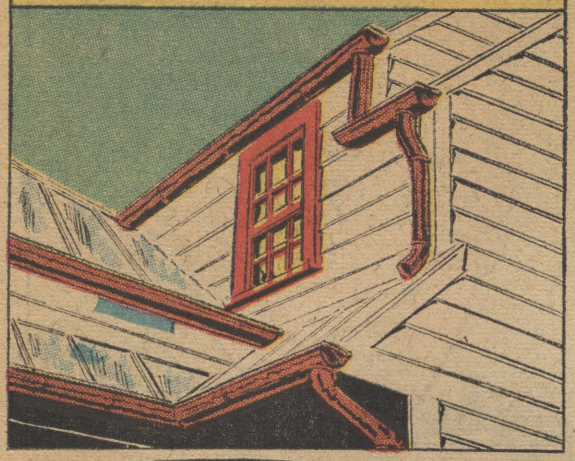
...IN THE BUILDING OF A SINGLE SHIP, THE QUEEN MARY, AN ESTIMATED 3 MILLION POUNDS OF COPPER WAS USED!"

"RADIO AND TELEVISION USE VERY LARGE QUANTITIES OF THIS METAL BECAUSE IT IS THE BEST COMMERCIAL CONDUCTOR OF ELECTRICITY...

...ABOUT 42 MILLION POUNDS ARE NEEDED EACH YEAR IN THE PRODUCTION OF NEW SETS!"

"ANOTHER FIELD--AIR CONDITIONING AND REFRIGERATION--IS MAKING INCREASING DEMANDS FOR THE 'RED METAL'. AT PRESENT, THE INDUSTRY USES OVER 65 MILLION POUNDS A YEAR!"

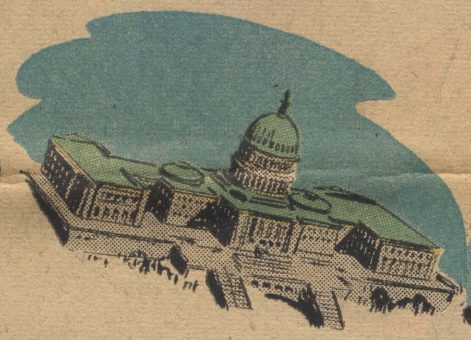
"THE POST-WAR CONSTRUCTION BOOM HAS ALSO BROUGHT AN INCREASED DEMAND FOR COPPER. YOUR OWN HOUSE OR APARTMENT BUILDING PROBABLY HAS COPPER RAIN SPOUTS AND PLUMBING LINES..."



"BUT COPPER HAS ALWAYS BEEN IMPORTANT IN CONSTRUCTION WORK. CHRIST CHURCH IN PHILADELPHIA, WHERE GEORGE AND MARTHA WASHINGTON ATTENDED SERVICES, HAS A COPPER ROOF OVER 200 YEARS OLD!"

"TO GIVE YOU AN IDEA ABOUT BUILDING CONSTRUCTION, HERE ARE SOME INTERESTING FACTS ON BUILDINGS WHICH YOU'VE HEARD A LOT ABOUT...

...THE EMPIRE STATE BUILDING, TALLEST IN THE WORLD, REQUIRED MORE THAN 1 MILLION POUNDS OF COPPER AND BRASS.



...THE UNITED STATES CAPITOL IN WASHINGTON, D.C. IS PROTECTED BY A COPPER ROOF.

...AND THE UNITED NATIONS GENERAL ASSEMBLY BUILDING HAS A COPPER DOME AND GUTTERS!"

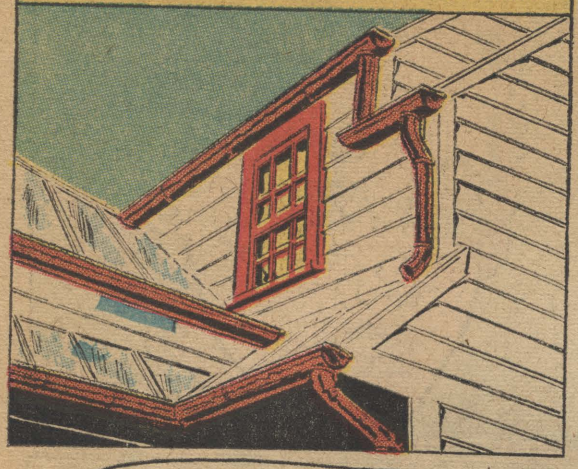
THERE ARE A THOUSAND OTHER INTERESTING USES, TOO, WHICH WE WON'T BE ABLE TO GO INTO AT THIS TIME, BUT I AM SURE YOU KNOW TWO OF THE MAIN ONES...

"TWO COMMON USES OF COPPER YOU'RE ALL FAMILIAR WITH ARE IN CURRENCY AND JEWELRY...

...THE COINS WE USE AS MONEY TODAY, JUST AS IN THE DAYS OF CAESAR, CONTAIN A GREAT DEAL OF COPPER...

...AND NOW, AS ALWAYS, IT IS A MAJOR METAL USED IN MANUFACTURING JEWELRY!"

"THE POST-WAR CONSTRUCTION BOOM HAS ALSO BROUGHT AN INCREASED DEMAND FOR COPPER. YOUR OWN HOUSE OR APARTMENT BUILDING PROBABLY HAS COPPER RAIN SPOUTS AND PLUMBING LINES..."



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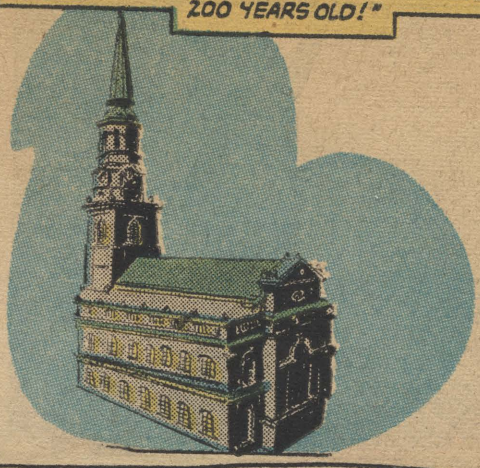

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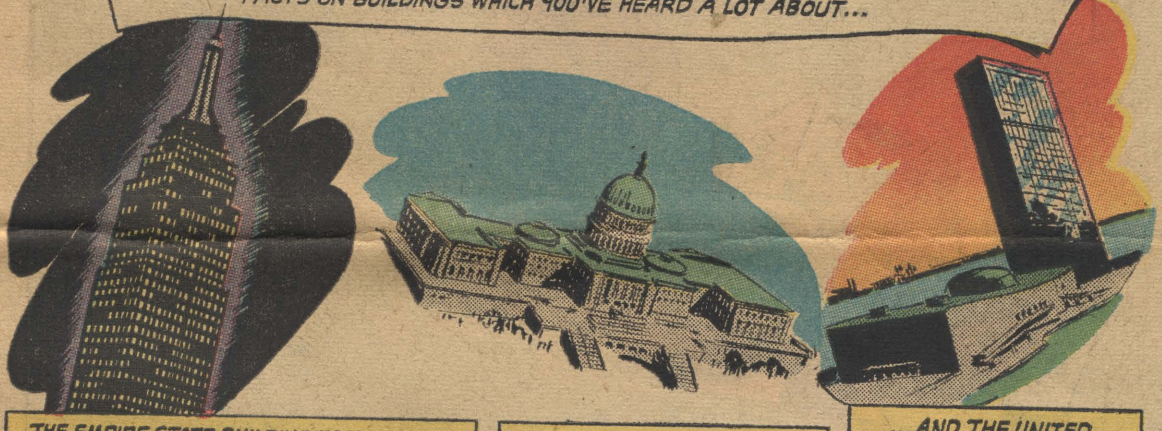

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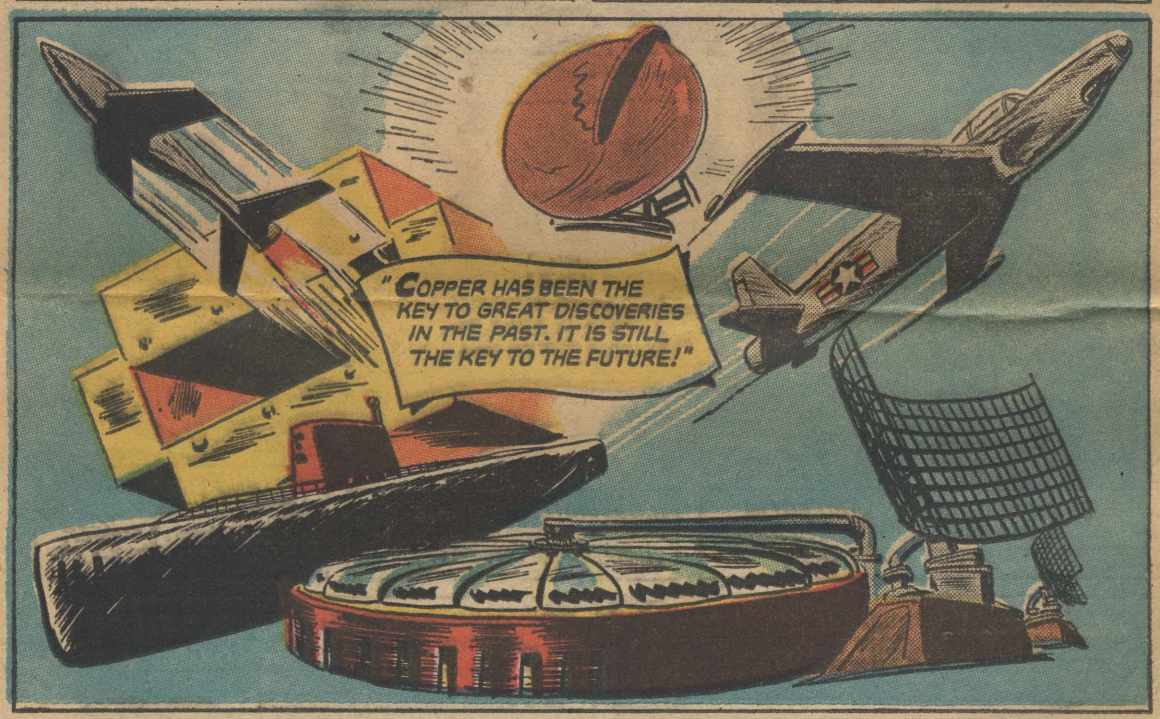
"IT IS A FITTING TRIBUTE THAT OUR GREAT SYMBOL OF FREEDOM, THE STATUE OF LIBERTY, IS MADE OF COPPER, THE METAL THAT HAS DONE SO MUCH TO KEEP OUR NATION STRONG AND FREE..."



THE **ANKH**, CONSISTING OF A CIRCLE SURMOUNTING A CROSS, IS BELIEVED TO HAVE BEEN DERIVED FROM A SIMILAR FIGURE THAT REPRESENTED ENDURING LIFE TO THE ANCIENT EGYPTIANS. IT WAS USED TO DESIGNATE COPPER BY THE ALCHEMISTS OF THE MIDDLE AGES AND IS THE MODERN GRAPHICAL SYMBOL FOR COPPER:

♀

THE FACTS CONTAINED HEREIN HAVE BEEN REVIEWED BY THE COPPER DIVISION, BDSA, U.S. DEPARTMENT OF COMMERCE, WASHINGTON, D.C.

THIS TEACHING AID HAS BEEN PRODUCED IN CONSULTATION WITH AN OFFICIAL COMMITTEE OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION.

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